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CLAIMS

1. Method for manufacturing non-contaminated MOX fuel rods (1), from pellets (6), in a containment enclosure (10) under a depression, the method comprising the following operations for one rod (1):

- loading of the pellets (6) in successive columns (12) into a cladding (2) previously provided with a first plug (3) at one of its two ends;

- loading of various structural components, in particular a retaining spring (7);

- fitting of a second plug (4) at the other end of the cladding (2);

- peripheral welding of said second plug (4), in particular if it is not fitted with tightening in said cladding (2); and

- at least one cleaning and at least one checking of the contamination of the parts of said cladding (2) or respectively of the rod (1) which have been exposed to contamination,

the method being characterised in that it comprises:

- division of the containment enclosure (10) into a number of successive compartments;

- connection of each compartment to its neighbour for a tight passage for the cladding (2), at least certain of said passages being aligned in order to allow a movement of the cladding (2) along a longitudinal axis;

- introduction of the cladding (2) to be loaded, the open end (34) in front, into a first compartment through a sealed passage or an input aperture thereto;

- axial driving of the cladding (2) between successive compartments until its open end (34) reaches the last compartment;

- loading of the pellets (6) in the last compartment, and if applicable also various structural components (5) other than the retaining spring (7), into the cladding (2) through its open end (34);

- partial axial withdrawal of the cladding (2), when the loading is finished, so as to convey its open end (34) into a preceding compartment;

- in this preceding compartment, cleaning and a possible contamination check of at least the part of the cladding (2) exposed to contamination by the pellets (6) in the process of being loaded or by the atmosphere of the last compartment;

- after this cleaning, axial movement of the cladding (2) so that the open end area (34) is positioned in another compartment;

- loading of the retaining spring (7) and fitting of the second plug (4) in the open end (34), in this other compartment;

- after this fitting, carrying out of possible other operations in the same compartment or in yet another compartment, with a possible additional movement;

- contamination checking of the parts of the rod (1) exposed to the contamination of the last compartments and possible cleaning if necessary, in the first or the second compartment;

- withdrawal of the rod (1) out of the first compartment or a transverse transfer to another containment enclosure via a first compartment connecting the enclosures to one another;

- stepping of the contaminations between the various compartments, starting from the non-contaminated or the very slightly contaminated in the first compartment to the most contaminated in the last compartment;

- selection of gases supplying the compartments, chosen from amongst the group formed by: air, nitrogen, helium, argon, vacuum;

- stepping of the depressions in the compartments, in order to organise any leaks, from the weakest depression in the first compartment to the strongest in the last compartment.

2. Method according to Claim 1, characterised in that, for loading of the pellets (6) and the following associated operations:

- presenting, centring and aligning the pellets (6) of a column (12) from a support (38) to the open end (34) of the cladding (2); and

the following are performed:

- correction of off-centrings between the support (38) and the open end (34) of the cladding (2), and alignment of the axis of the pellets (6) with the axis of the cladding (2), by means of a channel (42), the bottom of which has a V-shaped profile

in a continuous ramp and intersecting with a cylindrical output with the diameter of the pellets (6);

- centring of the cladding (2) in a chamber centred on the cylindrical part of the channel;

- masking of the open end (34) of the cladding (2) from the pellets (6) in the process of being loaded;

- trapping and/or collection and/or forcing back of dust and chips conveyed by and/or adhering to the pellets (6) loaded, and/or generated by the presentation, centring and alignment operations, via the free sections between pellets (6) and walls of the channel and/or grooves, by gravity deposition and optionally by additional blowing and/or suction.

3. Method according to one or other of Claims 1 and 2, characterised by loading of the pellets (6) of a column into the cladding (2), to a depth of introduction of the last pellet (6) in the cladding (2) equal to at least the length of the next column to be loaded into the same cladding (2).

4. Method according to any one of Claims 1 to 3, characterised in that loading of said pellets (6) in successive columns into said cladding (2) is performed by limiting the maximum pushing forces during loading, according to the depth of introduction of the pushing device and the order (N) of the column in the process of being loaded into the same cladding (2).

5. Method according to any one of Claims 1 to 4, characterised by a dry or slightly moist process for cleaning the parts of the cladding (2), or respectively of the rod (1), exposed to contamination, this process possibly being by rubbing.

6. Method according to any one of Claims 1 to 5, characterised in that the enclosure is divided into four compartments (I-IV), of which

- the fourth and last compartment (IV) is intended for loading of the pellets (6) and structural elements;

- the third (III) is intended for cleaning of the part exposed to contamination during loading;

- the second (II) is intended for loading of the spring (7) and fitting of the second plug (4), and possible girth welding thereof if the fitting is not with tightening; and

- the first (I) is intended for contamination checking and possible cleaning of the parts exposed to contamination in the preceding compartments, and for input of the cladding and output of the rod.

7. Method according to any one of Claims 1 to 6, characterised in that

- loading of the pellets (6), cleaning of the end of the cladding (2) exposed to contamination and fitting of the second plug (4) are performed in compartments under helium, as well as optionally the contamination measurement at the output;

- upon introduction of a cladding (2) empty of pellets into the containment enclosure (10), its open end (34) is transferred into the first compartment under helium encountered only after pumping out and replacement, between this compartment and the preceding one, of the gas contained in the cladding (2) with helium.

8. Method according to any one of Claims 1 to 6, characterised in that

- loading of the pellets (6) is performed in the last compartment under vacuum or in an enclosure under vacuum located therein; and

- upon introduction of a cladding (2) empty of pellets (6) into the containment enclosure (10), its open end (34) is transferred into this last compartment only after pumping out, between this compartment and the preceding one, of the gas contained in the cladding (2).

9. Device for manufacturing non-contaminated MOX fuel rods (1) from pellets (6), for implementation of the method according to any one of Claims 1 to 8, and comprising a containment enclosure (10) for carrying out the following operations:

- loading of the pellets (6) in columns (12) into a cladding (2) open at one end and closed by a first plug (3) at the other;

- cleaning and possible checking of the contamination of the part of said cladding (2) which has been brought into contact with contamination or dust from said pellets (6);

- loading of various structural components, in particular a retaining spring (7);

- fitting of a second plug (4);

- checking of the contamination and possible cleaning of the part of said cladding (2) which has been brought into contact with contamination,

the device being characterised in that:

- the containment enclosure (10) is divided into a number of distinct compartments;

- the compartments are preferentially in succession one after the other in a direction of movement between compartments of a cladding (2) to be loaded, the open end (34) in front;

- the compartments of the enclosure are isolated from one another by sealed partitions having, for passing the cladding (2) from one compartment to another, a tight passage (24), itself consisting of a full-passage valve (26) and a sealing device (28) on the circumference of the cladding (2), at least certain of said passages (24) being aligned in the direction of movement of the above-mentioned cladding (2), the first compartment encountered possibly being simply provided with an aperture at its input;

- at least one axial driving mechanism is arranged in order to move along its longitudinal axis the end of the introduced cladding (2) or of the rod (1) provided with its second plug (4) in the selected compartment;

- devices for loading the pellets (6) in columns (12) and means of loading various structural components (5) other than the retaining spring (7) and the second plug (4) are installed in the last compartment;

- at least one device for cleaning and possible means of checking contamination of the part of the cladding (2) exposed to contamination during loading of the pellets (6) are installed in a preceding compartment;

- means of loading the retaining spring (7) and of fitting - with tightening or not - the second plug (4) in the open end

(34) of the cladding (2) are installed in another preceding compartment;

- means necessary for carrying out possible additional welding and/or pressurisation operations can be installed in the same compartment or in yet another compartment;

- means of checking contamination and possibly of cleaning of the parts of the rod (1) exposed to contamination during the preceding operations are installed in the first or second compartment;

- means of ventilating the enclosure (10), its compartments and any enclosures installed therein, and gas supply means, are installed in order to maintain the enclosure (10) at a depression compared with the atmosphere of the room and are arranged to provide

  - a selection of gas for each compartment, chosen from amongst the group formed by: air, nitrogen, helium, argon, vacuum; and

  - stepping of the depressions of the compartments - for the purposes of organising the direction of any leaks and contributing towards the stepping of the contaminations - from the weakest in the first compartment to the strongest in the last compartment.

10. Device according to Claim 9, characterised in that it comprises a device (14) for presentation, centring and alignment of the pellets (6) with a view to their loading into the cladding (2), itself

- consisting of a fixed metal component (14) with a channel (42) passing through it - the dimensions of the input (44) of which are chosen for accepting an off-centring of the pellets